Improving Quality of Service using Plastic Optical Fiber Technologyin LANs and its Advantage: Performance Analysis

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*Abstract - **Plastic optical fiber is a fiber technology developed decades ago with the purpose of providing low-data rate communication with a big advantage and plastic optical fiber (POF) links are becoming increasingly popular for applications such as computer or peripheral connections, control and monitoring, board interconnects and even domestic hi-fi. Unlike glass optical fibers (GOF), POF remains flexible while having a large diameter core and high numerical aperture, lead to a high capacity they can bring along the fiber. POF systems have been used extensively in automatic control equipment in rugged manufacturing environments under industrial standards. Transmission fiber the current bottleneck has been moved to the receiver side, especially due to its bandwidth limitations. Although the limitation has been reduced minimizing active areas and parasitic capacitances there are still bandwidth limitations that occur because of the bounding-wire inductance. The paperexplored the Improving Quality of Service using Plastic Optical Fiber Technology in LANs and its Advantage.***

*KEYWORD: Quality of Service,Plastic Optical Fiber, Technology*

I. INTRODUCTION

Plastic fiber technology remains one of the challenges for small office / home office network deployments compared to glass fiber technology today. Polymer fibers, in fact, are less fragile and more flexible than glass and should reasonably restrict their use to home / office applications where their easy handling should help the "Do It Yourself Concept" (DIY). PolyMethylMethAcrylate (PMMA) and perfluorinated graded index polymer optical fibers (POF) of the commercially available plastic fibers represent the two main candidates capable of being used for high-speed / medium-range home / office networks due to their bandwidth compared to the step index, capabilities.

The multi-service distribution concept developed here for PFGI-POF originates from the combined use of high bandwidth fiber and Coarse Wavelength Division Multiplexing (CWDM) technique to fully exploit PFGI-POF bandwidth capacities. The study reported here has the advantage of multiplexing several PFGI-POF services. According to plastic fibers' high bandwidth products at both 850 nm and 1,300 nm, the idea is to extend the existing classic baseband network to a dual

concept providing indoor coverage of wireless signals transmitted using Radio over Fiber technology. This concept is very useful when both transmitted signals show potential overlapped spectrum.

Wavelength division multiplexing (WDM) is a technique that modulates different data sources, i.e. optical carrier signals of differing wavelengths of laser light colors on a single optical fiber. Wavelength division multiplexing WDM is similar to frequency-division multiplexing (FDM), but refers to light frequency wavelength. WDM is achieved in the electromagnetic spectrum IR section instead of radio frequencies (RF).

Every IR channel carries multiple RF signals combined with FDM or Time-Division Multiplexing (TDM). At the endpoint, each multiplexed infrared channel is isolated or demultiplexed into the original signals. Using FDM or TDM in each IR channel in combination with WDM, data can be transmitted simultaneously on a single fiber at different formats and speeds. It raises network efficiency slowly and cost-effectively.
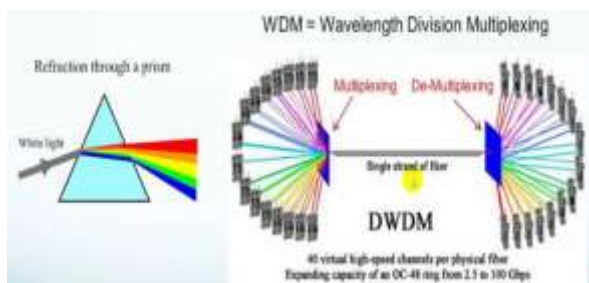
Figure 1: Wavelength Division Multiplexing (WDM)

WDM allows bi-directional communication and multiplies signals. Separate signal set modulates each laser beam. Because wavelength and frequency are reversed (shorter wavelength means higher frequency), both WDM and FDM use the same technology. The receiving end uses Wavelength-sensitive filters, visible-light color filters IR analog. Early 1970s conceptualized the first WDM technique. Subsequently, Wave Division Multiplexing (WDM) systems were able to handle 160 signals extending a 10 Gbit / second network with a single fiber optic pair of conductors to over 1.6 Tbit / second (i.e. 1,600 Gbit / s). The first two-channel WDM systems used 1310 nm and 1550 nm wavelengths. Soon thereafter came multi-channel systems utilizing the area of 1550 nm, where fiber attenuation is lowest.
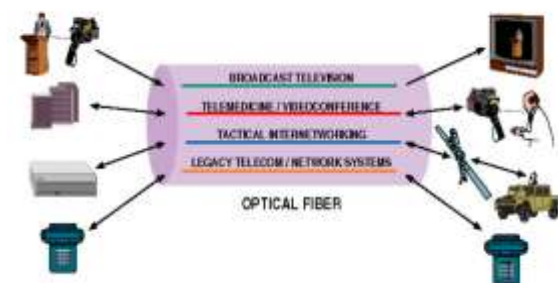
Figure 2: WDM through Optical Fibre

Multiplexing devices can combine signals with multiplexing and isolate them with a demultiplexer. WDM systems are popular with telecommunications companies as they allow them to expand network capacity without using WDM and optical amplifiers. Such two devices act as drop multiplexer (ADM), i.e. adding light beams simultaneously while dropping other light beams and redirecting them to other destinations and devices and making this form of light beam filtering possible with e heels, devices called Fabry-Perot interferometers using thin-film optical glass.

Generally, WDM systems use single-mode optical fiber (SMF) in which only one light ray has a core diameter of 9 millionths per meter (9 μm). Many systems with multi-mode fiber cables (MM Fiber) also called cableshave core diameters of around 50 μm. Present modern networks can accommodate up to 128 signals and extend a standard 9.6 Gbpsfiber network to over 1000 Gbps. Often used for optical fiber communication, transmitting data in multiple channels with minor difference in wavelengths. WDM will increase point-to - point overall bit rates.

Uses of Wavelength Division Multiplexing:

- WDM multiply the effective bandwidth of a fiber optic communications system

- A fiber optic repeater device called the erbium amplifier can make WDM a cost-effective and it is the long-term solution.

- This reduces the cost and increases the capacity of the cable to carry data.

- Wavelength Division Multiplexing (WDM) uses multiple wavelengths (colors of light) to transport signals over a single fiber.

- It uses light of different colours to create a number of signal paths.

- It uses Optical prisms to separate the different colours at the receiving end and optical prisms does not require power source.

- These systems used temperature stabilized lasers to provide the needed channels count.

WDM systems are divided by wavelengths, WDM (CWDM) and WDM (DWDM). CWDM operates with 8 channels (i.e. 8 fiber optic cables) called the "C-Band" or "erbium window" with wavelengths of about 1550 nm (nanometers or billions of meters, i.e. 1550 x 10-9 metres). DWDM also operates in the C-Band, with 40 channels spacing 100 GHz or 80 channels spacing 50 GHz. Often WDM systems run on single-mode optical fiber cable shaving a core diameter of 9 μm. Wavelength division multiplexing is a technique where different optical signals are combined, transmitted and separated.

. II. OBJECTIVES

- To study Bandwidth utilization is indeed a key characteristic for improving quality of service In LANs.

- To assess the broadband communication technology using optical fiber has spread quickly through internet lines.

- To study the Optical fiber uses light pulses instead of electrical pulses to transmit information.

III. BASICS OF WAVELENGTH DIVISION MULTIPLEXING, WDM

Wavelength division multiplexing, WDM, has long been the preferred technology to move large quantities of data between sites. This improves bandwidth by allowing simultaneously transmitting multiple data streams over a single optical fiber network. Thus, WDM maximizes fiber utility and helps optimize network investments. Traditionally, carriers and service providers implemented WDM systems. Large-scale networks planned for "public infrastructures" made the networks too costly and complex for private network use. Things have improved in recent years. And the technology is evolving rapidly. Today, WDM networking solutions are available that meet the needs of corporate companies, governmental organizations and private datacenters. Many organizations have yet to discover WDM networking benefits and how to use it to maximize network investments and maximize fiber networks.

Many organizations have yet to discover the benefits of wavelength division multiplexing, WDM, networking and how it can be used to help maximize network investments and get the most out of fiber networks.

WDM's foundation lies in the ability to light different data types across fiber networks. By allowing different light channels to be sent simultaneously to a single virtual fiber network, each with a unique wavelength. Instead of using multiple fibers for each service, one fiber can be shared for multiple services.
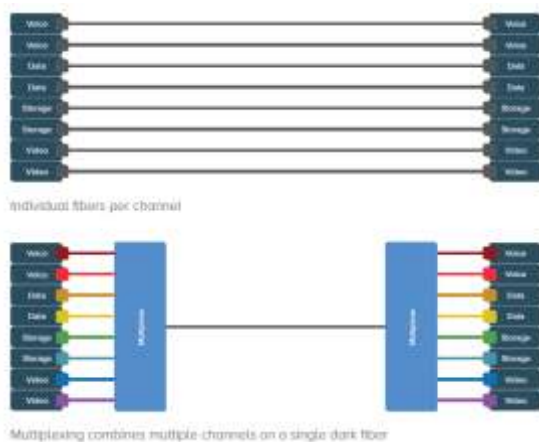

Figure 3

Thus, WDM increases bandwidth and maximizes fiber usefulness. Fiber leasing or lease is a large share of networking costs. Use an existing fiber to carry several channels will produce significant savings. The simplest WDM device consists of four elements:
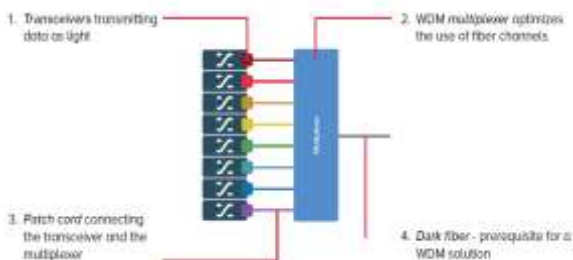

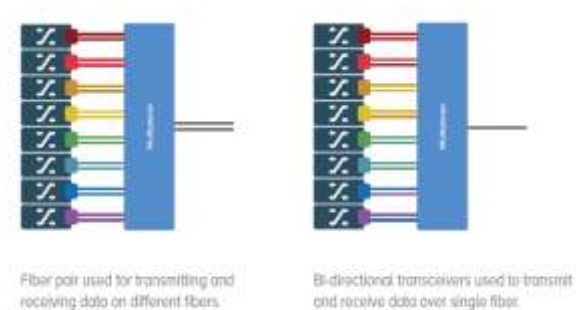Figure 4

Transceivers – transmitting data as light

Transceivers are wavelength-specific lasers that convert data signals from SAN and IP switches to fiber-transmitting optical signals. Each data stream is transformed into a light wavelength signal, a unique color. Owing to the physical properties of light, channels cannot interfere. All WDM wavelengths are independent.

This way, creating virtual fiber channels means reducing the number of fibers needed by the wavelength factor used. It also allows connecting new channels as needed, without disrupting existing traffic services. As each channel is transparent to data speed and type, any mix of SAN, WAN, voice and video services can be transported simultaneously over a single fiber or fiber pair..

Multiplexers optimizing the use of fiber channels

The WDM multiplexer, also called passive mux, is the secret to optimizing or maximizing fiber use. The multiplexer is at the center of the process, gathering all data streams to be transmitted simultaneously over a single cable. At the other end of the cable, the streams are demultiplexed, i.e. separated into separate channels.

The WDM multiplexer is at the heart of the operation, gathering all data streams together to be transported simultaneously over a single fiber.

Fiber pair used for transmitting and receiving data on different fibers.

Bi-directional transceivers used to transmit and receive data over single fiber.

Figure 5

Early WDM devices transported two bi-directional channels over a pair of fibers. The technology has advanced rapidly, increasing the number of channels and the amount of data transmitted per channel. At any time, up to 80 channels can be simultaneously transmitted down a fiber. Since they are usually positioned in a network at the endpoints, multiplexers are often called terminal muxes. A multiplexer is positioned at each site when connecting two sites, creating point-to - point connection.

For certain cases, networks have additional sites where connectivity is necessary, but not for all traffic types. Here, optical drop multiplexers (OADMs) are used to obtain the appropriate wavelengths required for the particular site while bypassing unnecessary traffic types. This creates more robust chain, delivery and connection networks.

Patch cord connecting the transceiver and the mux

The transceiver transmits high-speed data protocols on narrow band wavelengths while the multiplexer is the operation's core. Patch cable is the glue that unites these two key elements. LC connector cords are popular, and connect the output of the transceiver to the input on the multiplexer.

Dark fiber: Fiber pair or single fiber strand

Any WDM solution requires access to a dark fiber network. A fiber pair is the most common way to carry optical traffic over architecture. Each of the fibers is used for data transmission, the other for data reception. This makes transportation to full traffic. Often only one fiber is available. Since different light colors move on different wavelengths, an independent WDM system can be developed. One wavelength is used to send data, another to receive it.

The techniques to augment the spine network capacity given the optical fiber communication essentially incorporate Space Division Multiplexing (SDM), laying of new fiber optic cable, Time Division Multiplexing (TDM), the increment of the transmission rate and Wavelength Division Multiplexing (WDM)/expanding the number of multiplexing wavelength. All WDMs specified in this research allude to Dense WDM (DWDM). WDM is right off the bat proposed as a transmission technology, which can make full utilization of the gigantic fiber bandwidth assets to expand the transmission capacity of a bit of optical fiber by a few times, many times or even several times contrasted and a solitary wavelength.

Also, each channel of WDM is transparent to data organize, to be specific having nothing to do with the flagging rate and the electrical tweak mode. In network extension and development, WDM is the perfect methods for development and the helpful method to present new broadband services. New services or new capacity can be generated by expanding the wavelength.

IV. INTELLIGENT (AUTOMATIC) OPTICAL NETWORK

Wavelength Division Multiplexing (WDM) is to unite the optical bearer signal (conveying an assortment of information) with two or various diverse wavelengths at the transmitting terminal by methods for the multiplexer (otherwise called combiner), which is coupled to a similar fiber for transmission[1]. At the accepting terminal, the de-multiplexer (otherwise called wave splitter or de-multiplexer) is used to separate optical transporter with different wavelengths, and after that, the optical collector is utilized for additionally preparing to reestablish the first signal.

The technology to transmit two or various optical signals with various wavelengths in a similar fiber is named Wavelength Division Multiplexing. WDM is the frequency division multiplexing (FDM) technology in the optical area. The way of every wavelength is accomplished through frequency-area division and involves the bandwidth of a segment of optical fiber. Wavelengths utilized as a part of the WDM framework is extraordinary, to be specific the particular standard wavelengths.

Channel spacing of CWDM is 20nm, yet that of DWDM is from 0.2nm to 1.2nm; along these lines, CWDM is known as the Coarse Wavelength Division Multiplexing technology contrasted and DWDM. Nonetheless, the WDM technology has its attributes. On the off chance that telecom administrators need to acquire great network execution at the lower cost of network development and establish the framework for the updating of the network, later on, these qualities ought to be considered, which must be founded on to actualize sensible planning. This presents an issue about the transmission network planning.

Network planning strategy

In planning the transmission network, bandwidth interest for the distinctive telecommunication services is thought to be known. Bandwidth request is obtained by anticipating and breaking down development of different services. The motivation behind the planning procedure is to draw up an upgraded plan to take care of the demand under certain specialized and financial requirements.

Primary contributions of the network planning process gave by the administrators incorporate the gauge of the administration transmission requests amid the planning time frame and the current network structure worked by the administrators[2].

Advancement consequences of network planning will detail an assortment of information including course used to accomplish and re-establish benefit transmission ask for, asset allotment information (counting working course and securing/re-establishing the transmission course), network expenses and asset use (completely improve utilization of existing assets). Transmission network planning is extremely unpredictable, through which the integrated planning issues are typically be separated into littler sub-issues by methods for the disintegration strategy, in this manner lessening multifaceted nature of the integrated planning process; the decay technique is thought to be the reasonable arrangement generally utilized as a part of SDH transmission network[3-9].

Network optimization module

The principal assignment of the network enhancement module is to modify the configuration amid network task, to influence the network to keep running under the streamlined conditions and to

enhance usage, quality, and heartiness of the network. Primary applications situations incorporate three focuses as follows: For recently arrived services (or changed services), wavelength and steering portion of the network might be required to be acclimated to meet the necessity for bandwidth and grade of administration; right now, it is superfluous to alter wavelength and directing assignment for all services, and the alteration guideline is to limit the effect on the net benefit.

The distinction between the capacity and programmed end-to-end configuration work is that course and wavelength allotment for different services can be balanced here, while the conclusion to-end configuration work falls flat.

V.OPTIMIZATION OF BANDWIDTH TECHNIQUES IN VOIP SERVICES PATTERN TO IMPROVE THE SERVICE QUALITY: PERFORMANCE ANALYSIS

The amount of voice traffic on IP networks continues to increase rapidly, with strong growth in Skype, Tango and other voice applications. Voice over Internet Protocol (VoIP) also called IP Telephony, Internet Telephony, Broadband Telephony, Broadband Phone and Voice over Broadband, a technology that unveils a communication network that enables voice signals and data to be transmitted and received over the internet.

While using the Internet Protocol as the most basic transport mode used by both TCP and UDP, VoIP system uses designated codecs that convert voice signals into digital data forms (bits) resulting in output transmitted over the internet via networked infrastructure. Typically, these bits are replicated at destination using data attributes and timestamps accordingly. Equitable cost savings, easy deployment while leveraging existing infrastructure, scalability, improved productivity, flexibility and mobility are key drivers of this technology's proliferation. FCC predicted 44% of corporate organizations would run VoIP lines by 2008. In time, VoIP technology (applications and schemes) will replace traditional Public Switched Telephone Network (PSTN) technology. This ascendancy over PSTN is and will continue to be driven by numerous factors; notably higher reliability due to systematic and automated side-stepping of inherent network challenges over congestion; ability to execute calls, regardless of geographical location, using computers or other mobile devices.

Nonetheless, voice traffic occurs in real-time and is based on tiny UDP packets, so enormous network loads are being exercised due to the advent of massive packets per second per phone call. Additionally, bandwidth-enabled voice applications are highly inefficient, as packet header sizes are often the same as the overhead payload size of nearly 40%. Moreover, acceptable use standards advocate efficient service quality, a paradigm that describes the gratification level experienced by users of any VoIP application.

Optimization techniques

There are essentially three major techniques for improving bandwidth utilization in a VoIP network/service, which include; header compression/suppression (sometimes with coalescing, aggregation or prioritization), packet header reduction, and Silence suppression.

Voice / Packet Header Compression

This refers to the phenomenal representation that compacts voice packets from the default 40 byte size to a smaller 2 byte size at best. Compression and decompression codecs are used for this. Codecs convert voice signals from analog to digital, and compress digital voice using digital compression algorithms. Compressed information is transformed into frames (packet payload) of varying sizes depending on the codec type used and its efficiency. Many simple facts inspire header compression to maximize bandwidth.

Compressed Real-time Transport Protocol (cRTP) Compression

Internet Protocol (IP) telephony services use RTP protocols for their operations, so with the help of the Compressed Real-time Transport Protocol (CRTP), IP / UDP / RTP headers of each voice packet can be compressed from conventional 40 bytes or more to as small as 2 bytes. Packet loss rate at the receiver ends after each successful decompression, however effective for compression, has been noted to be too high Evidently showing that cRTP unaided may not offer the best solution for header compression in cellular & VoIP links; since packets are immensely lost.

Performance Analysis

In recent years, a variety of technologies and approaches have been developed and introduced to maximize the number of users in the network and to transmit the data with minimal losses to the highest possible range. In this research, DWDM technology features, Hybrid amplifiers, and FSO are merged into a single system to improve system performance. The research also involves variation of various device parameters, such as channel size, attenuation, modulation type, channel spacing, and data rates.

This is assumed that for transmission a nominal value of channel spacing should be chosen as the increased value of channel spacing results in greater usage of bandwidth and decreased values result in interference between the channels. In the program several compensation methods are often introduced to produce the best performance. Although the number of channels in a network varies, it is observed that 30 channel systems display better results followed by 40, 50 and 60 channel configurations, and that the network-supported FSO range is less than 3 km.
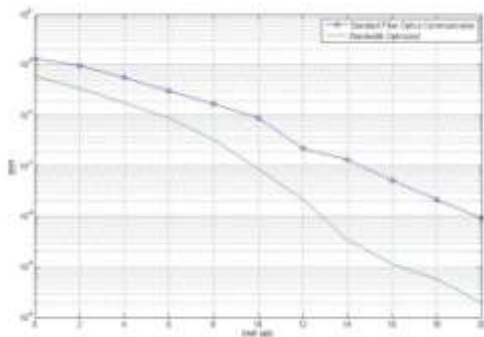

Figure 6 comparison between standard fiber optic communication and bandwidth optimized
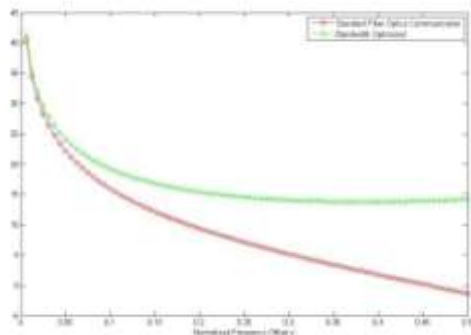
Figure 7comparison between standard fiber optic communication and bandwidth optimized
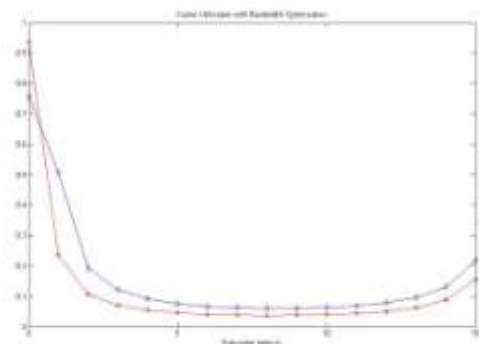

Figure 8 Carrier utilization with bandwidth optimization

The change in attenuation for different systems has been shown to best perform 30 channel system followed by 40, 50 and 60 channel setup, although a serious signal distortion for attenuation value greater than 10 dB / km is observed. If the optical source modulation format in 30 channel system differs from RZ to NRZ format, results for RZ modulation are found to be stronger than the latter.

Compensation techniques are used to compensate the losses in the system, and the post-compensation technique also shows best performance followed by pre-compensation, symmetric-compensation and uncompensated. A post-compensated setup is noted to perform better followed by pre-, symmetric & uncompensated models. The research work also includes the incorporation into the system of various amplifiers including a hybrid combination to obtain the better results. Using the EDFA & SOA mix of SOA & hybrid expands the range of FSO connections beyond 4 Kms to 12 Kms.

VI. CONCLUSION

Maintaining excellent user voice services is a major concern for VoIP service providers; a fast (no or minimal delay) and efficient VoIP service. However, accelerating VoIP traffic is ambiguous and sometimes misleading. Why? Why? Since VoIP traffic, like all other IP traffics, travels at light speed. Thus, network congestion and other relevant issues that could lead to despoiled voice quality will delay it.

This research surveys the various schemes ad techniques that can be implemented to maximize bandwidth in Voice-Over Internet Protocol Networks and (or) Services Several schemes and(or) techniques have been suggested as feasible solutions for enhancing bandwidth usage, and this discourse seeks to study the various techniques in order to evaluate the respective weaknesses.

Optimizing bandwidth, especially for VoIP systems, is a crucial need. Confronted by an increasingly competitive data and VoIP market trend, as well as the realities of declining voice service revenues per customer, communications operators and service providers are finding approaches that can lessen the odds while at the same time placing them in a better, profitable position.

These companies need so many reasons and ways, and can benefit from optimization. First, nearly 40% of most VoIP packets are headers. Nevertheless, most headers hardly alter, creating redundancies during transmission. Such redundancies continue with call frequencies despite similarities in source and (or) destination IPs, with no sharing provision.

Other reasons include the fact that Ineffectiveness applies to all UDP streams, ranging from standard VoIP applications such as Skype to smaller packet applications not using full-frame video streaming. Obviously, these real-time streams require management and priority for effective quality-size tuning, minimal impact and quality improvement.

To achieve this multiple technologies are being developed. The introduction of super-channels, which reduces the channel gap close to the Nyquist bandwidth, is another important development. Bandwidth utilization is indeed a key feature of improving the quality of service in VoIP networks and applications; this is due to the fact that communications operators and service providers continue to seek solutions that can reduce their chances while at the same time achieving successful positions in the current competitive environment. And given the varied bandwidth utilization techniques (Voice / Packet Header Compression with Aggregations, Reduction and Silence Suppression) for which scalability, improved productivity, flexibility, and service cost reduction are key goals.

REFERENCES

1. Melián, B., Laguna, M., and Moreno, J.A., "Capacity expansion of fiber optic networks with WDM systems: Problem formulation and comparative analysis", Computers and Operations Research, 31(3) (2004) 461-472

2. Abhishek Dixit, Bart Lannoo, Goutam Das, Didier Colle, Mario Pickavet,"Dynamic Bandwidth Allocation with SLA Awareness for Qos in Ethernet Passive Networks", Journal Optical Communication Network, Vol. 5, No. 3, 2013.

3. Ehsan A. A. Shaari S., Rahman M. K. A. Plastic Optical Fiber Coupler with High Index Contrast Waveguide Taper. Progress in Electromagnetics Research C, 2011; 20 125-138.

4. Haupt M., Fischer U. H. P. Multi-colored WDM over POF system for Triple-Play. In: Proceedings of SPIE 6992: Micro-Optis 2008, 699213-699213-10

5. Pena J. M. S., Rodríguez I., Vázquez C., Pérez I., Otón J. M. Spatial Distribution of the Electric Field in Liquid Crystal Dispersions Devices by using a Finite-Element Method. Journal of Molecular Liquids 2003; 108(1-3) 107-117.

6. Pena J. M. S., Vázquez C., Pérez I., Rodríguez I., Otón J. M. Electro-optic System for Online Light Transmission Control of Polymer-Dispersed Liquid Crystal Windows. Optical Engineering 2002; 41(7) 1608-1611.

7. Zubia J., Durana G., Arrue J., Garces I. Design and Performance of Active Coupler for Plastic Optical Fibres. Electronics Letters 2002; 38(2) 65-67.

8. Lallana P. C., Vázquez C., Vinouze B., Heggarty K., Montero D. S. Multiplexer and Variable Optical Attenuator Based on PDLC for Polymer Optical Fiber Networks. Molecular Crystals and Liquid Crystals 2008; 502(1) 130-142.

9. Chen R. H. Liquid Crystal Displays: Fundamental Physics and Technology. Hoboken: Wiley; 2011.